WINTER BIRD DENSITIES ON NORTH AND SOUTH SLOPES

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Cantlon (1953), in New Jersey, and Smith (1966), in West Virginia, have shown that, in winter, south slopes are characterized by higher air temperatures and lower wind velocities and relative humidity than contiguous north slopes. Part of this difference stems from greater solar incidence on south slopes. A south slope in North Carolina has been recorded receiving over twice the radiation of a contiguous north slope in winter (Swift and van Bavel, 1961). In New Jersey, these effects produce south slopes that are host to a more xeric forest aspect, with lower values of tree and shrub density and tree basal area (Cantlon, 1953). In view of these differences, we decided to survey the densities of selected resident bird species on a north and south slope in a contiguous forest. As vegetational differences could conceivably affect bird distribution, we surveyed vegetation as well as the avifauna.

METHODS

We worked in the deciduous forest of the Watchung Reservation, Union County, New Jersey. The study area consisted of two ridges, running in an east-west direction, giving the slopes direct northern or southern exposure. We chose six 0.5 mile (0.8 km) transects, 3 each on the north slope (mean height, 165 m; mean slope, 7°) and 3 on the south slope (mean height, 160 m; mean slope, 8°) of parallel ridges. The ridges are at no point separated by less than 0.4 km or more than 1.6 km.

We ran nine bird censuses on each transect, three each in October, November, and December 1972. All censuses were conducted between 07:30 and 10:30, with 20–25 minutes allowed per transect and all transects sampled on each census day. Starting times for each transect were rotated randomly. We counted the six most abundant species, Downy Woodpecker (*Dendrocopos pubescens*), Blue Jay (*Cyanocitta cristata*), Black-capped Chickadee (*Parus atricapillus*), Tufted Titmouse (*Parus bicolor*), White-breasted Nuthatch (*Sitta carolinensis*), and Cardinal (*Cardinalis cardinalis*). All individuals seen or heard within a lateral distance of 412 feet (126 m) were noted. Transect data were transformed into densities using the coefficient of detectability method of Emlen (1971), based on data from both slopes. Probabilities of significance were determined by factorial analysis of variance (Sokol and Rohlf, 1969).

For vegetation analysis, eight 80 m^2 quadrats were randomly chosen within each bird census plot. Within each quadrat, all trees (D.B.H. > 10cm) were identified and their basal areas calculated. Within each tree quadrat, a 6 m^2 subquadrat was randomly selected in which all shrubs (D.B.H. > 2.5 cm; height > 30 cm) were identified.

RESULTS

The vegetation sampling showed that the north slope supported 26 species of trees and shrubs, and the south slope 24 (Tables 1 and 2). One species of tree and four of shrubs that occurred on the south slope were absent from

TABLE 1

TREE SPECIES COMPOSITION

Species	North Slope		South Slope	
	Density[1]	Importance[2]	Density	Importance
Quercus rubra	22	78.9	19	77.4
Liriodendron tulipfera	16	52.1	13	52.1
Quercus velutina	3	10.6	14	50.2
Acer rubrum	4	15.1	7	36.2
Fraxinus americanus	8	20.5	6	18.7
Betula lenta	11	36.2	—	—
Cornus florida	1	3.0	7	24.1
Tsuga canadensis	4	11.5	3	11.3
Quercus alba	4	15.8	2	8.9
Fagus grandifolia	8	21.1	—	—
Acer saccharum	4	15.7	1	4.5
Sassafras albidum	—	—	4	11.5
Betula lutea	2	4.2	2	5.1
Quercus prinus	2	8.0	—	—
Tilia americana	3	7.3	—	—
Total	92		78	

[1] Density is based on the entire 1920 m^2 area sampled on each slope.
[2] Importance values are derived by adding the total relative frequency, density and dominance (Curtis and Cottam, 1950).

the north slope; vice versa, the figures were four and three. Two of the north slope dominants, *Betula lenta* and *Fagus*, were absent from the south slope, versus none in the opposite comparison. In addition, the forest of the north slope accounted for slightly more of the total basal area of the two slopes (i.e. 54 percent) and the canopy averaged slightly higher (i.e. 22.5 versus 21.0 m).

All six bird species censused showed significantly higher densities on the south slope ($P < .001$; F-test). The differences in densities between slopes varied between species, with south slope density values ranging from three to more than twenty times north slope values (Table 3).

DISCUSSION

Although similar floristically, the forests on the north and south slope in our study area differ in species composition and in dominants. The south slope is more xeric, having a lesser density of trees and shrubs, lesser tree basal area, and a lower canopy. The differences that we found show the same trend as those found by Cantlon (1953), although his were of a greater magnitude.

The difference in avian densities on the two slopes probably relates to

TABLE 2

SHRUB SPECIES COMPOSITION

Species	North Slope Density[1]	North Slope Importance[2]	South Slope Density	South Slope Importance
Viburnum acerifolium	602	108.6	168	71.6
Cornus florida	21	7.1	128	64.5
Parthenocissus quinquefolia	48	18.2	50	27.3
Rhododendron nudiflorum	70	16.1	—	—
Corylus americana	36	16.7	2	1.9
Gaylussacia baccata	35	7.4	—	—
Hamamelis virginiana	15	9.6	10	8.4
Rhus radicans	6	5.3	8	7.9
Vitis aestivalis	4	2.1	6	4.5
Rubus frondosus	—	—	8	3.4
Cornus alterniflora	3	1.9	4	2.4
Amelanchier arborea	6	5.3	—	—
Rosa carolima	—	—	4	2.4
Cornus racemosa	—	—	3	2.2
Cornus rugosa	—	—	2	1.9
Vaccinum vacillans	1	1.7	1	1.6
Total	847		394	

[1] Density is based on the entire 144 m^2 area sampled on each slope.
[2] Importance values are derived by adding the total relative frequency and density (Curtis and Cottam, 1950).

differences in habitat. What particular aspect(s) of the habitat the birds were reacting to is not so obvious, although one might predict one consideration would be the distribution of plant and/or animal food. The Blue Jay, Tufted Titmouse, and White-breasted Nuthatch all depend on oaks and

TABLE 3

BIRD DENSITIES ON NORTH AND SOUTH SLOPES

Species	North Slope Birds Per Mile (1.6 km)[1]	North Slope Birds Per 100 acres	South Slope Birds Per Mile	South Slope Birds Per 100 acres	Percent[2]
Downy Woodpecker	0.11 ± .10 (6)	0.6	0.82 ± .13 (22)	4.3	79%
Blue Jay	0.93 ± .15 (25)	3.9	4.07 ± .19 (110)	17.0	81%
Black-capped Chickadee	0.93 ± .16 (25)	4.8	4.22 ± .42 (114)	22.0	82%
Tufted Titmouse	0.07 ± .04 (2)	0.4	1.48 ± .19 (40)	9.0	95%
White-breasted Nuthatch	0.41 ± .11 (11)	2.4	1.56 ± .18 (42)	9.3	79%
Cardinal	0.63 ± .16 (17)	4.7	2.22 ± .26 (60)	16.9	78%
Total		16.8		78.5	

[1] ± standard error of the mean (number of birds).
[2] Percent of total birds counted that were present on the south slope.

beeches for the major portion of the plant content of their diet (Martin et al., 1951). On this basis. the north slope should be more attractive to these species. The plant foods of the Black-capped Chickadee in our study area included eastern hemlock (*Tsuga canadensis*) and poison ivy (*Rhus radicans*) (Martin et al., 1951): as these are about equally abundant on both slopes. any slope preference based on availability of these plants as food seems unlikely. There is some possibility that plant food preference played a role in the higher south slope densities of Downy Woodpecker and Cardinal. as these species depend considerably on dogwoods (*Cornus* spp.). which were more abundant there.

We feel the possibility that the birds were reacting directly to the distribution of prey animals is unlikely. It has been shown that as vegetation becomes more dense. the insect fauna become more abundant (for a review see Lack. 1954). Thus. if insect prey density were the direct determinant of bird density. the north slope. and not the south. should have been preferred.

Although we did not obtain microclimatic data, there is little reason to believe that our study area is substantially different from those studied by Cantlon (1953) and Smith (1966). If this is true. it raises the possibility that during our winter study, the birds were avoiding the greater thermal stress of the north slope and remaining preferentially on the warmer, drier and less windy south slope. In his elaboration on climate-animal interaction, Gates (1969) states that as thermal stress rises. ". . . the homeotherm must adapt primarily by means of physiological adjustment combined with positioning within the habitat." One of the corollaries of Gates' model was the relationship between size of an organism and its susceptibility to thermal stress, i.e. as body size decreases, susceptibility to thermal stress at low temperatures increases. It is therefore reasonable to assume that the small birds we studied conserved energy by tending toward south slopes at low temperatures. Support for this assumption is found on examination of north slope occurrence as a function of mean air temperatures (Fig. 1). For five out of six species, lower air temperatures mean relatively fewer birds found on the north slope. We cannot explain the exception of the White-breasted Nuthatch, although this could be due to sampling error.

In conclusion, we feel that the most obvious factor influencing the avian distributions that we observed was the difference in climate between north and south slopes.

SUMMARY

In the late fall and winter, we conducted a distributional survey of vegetation and of six avian species on north and and south facing mountain slopes in New Jersey. Substantial differences in vegetation were found; the north slope supported a denser and more mesic plant community. The birds showed a great preference for the south slope

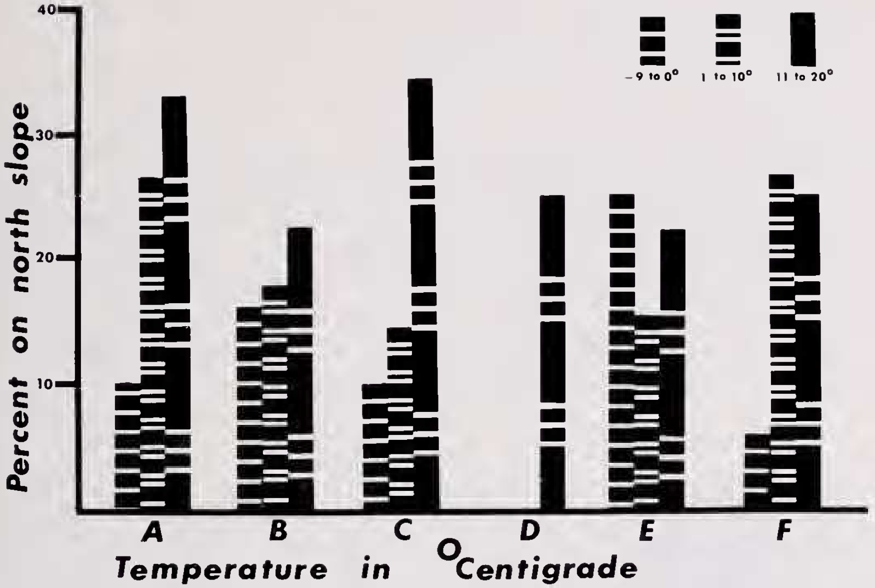

FIG. 1. Percentages on north slope of total individuals of six species counted on both slopes, as a function of temperature. Species A is Downy Woodpecker, B is Blue Jay, C is Black-capped Chickadee, D is Tufted Titmouse, E is White-breasted Nuthatch and F is Cardinal. The -9 to 0° temperature class is based on data from 3 census days, the 1 to 10° class on 4 days, and the 11 to 20° class on 2 days.

(82 percent of sightings for all species combined). We suggest that the birds were attracted to the warmer, drier and less windy conditions on the south slope, with any slope differences in food availability not being a major factor.

ACKNOWLEDGMENTS

We thank J. Burger for help on the figure.

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NEW LIFE MEMBER

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